Department of
Primary Industries and
Regional Development
GOVERNMENT OF
WESTERN AUSTRALIA

Research Library

Bulletins 4000 -

Research Publications

1990

A guide to barbed wire fence construction for range cattle control

J S. Addison

Follow this and additional works at: https://researchlibrary.agric.wa.gov.au/bulletins

Part of the Bioresource and Agricultural Engineering Commons

Recommended Citation

Addison, J S. (1990), *A guide to barbed wire fence construction for range cattle control*. Department of Agriculture and Food, Western Australia, Perth. Bulletin 4183.

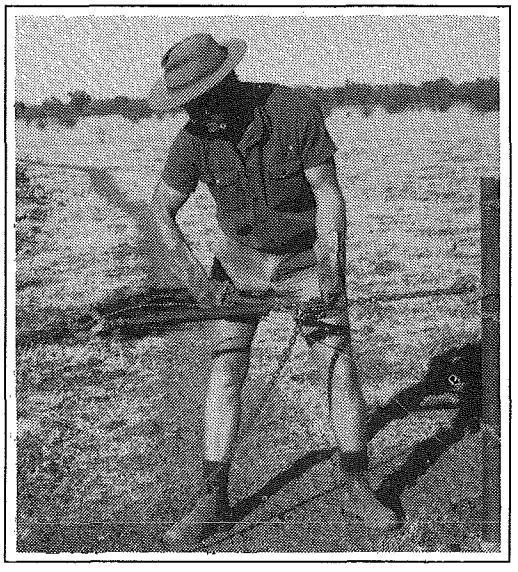
This bulletin is brought to you for free and open access by the Research Publications at Research Library. It has been accepted for inclusion in Bulletins 4000 - by an authorized administrator of Research Library. For more information, please contact jennifer.heathcote@agric.wa.gov.au, sandra.papenfus@agric.wa.gov.au, paul.orange@dpird.wa.gov.au.

Bulletin No. 4183
Agdex 723
ISSN 0729-0012

July 1990

Department of Agriculture - Western Australia

A guide to barbed wire fence construction for range cattle control



By Jim Addison, Technical Officer, Department of Agriculture, Derby

© Chief Executive Officer, Department of Agriculture, Western Australia 1990

A guide to barbed wire fence construction for range cattle control

By Jim Addison, Technical Officer, Derby

Contents

Introduction 4
Fenceline pegging 4
- Checking the line 4
- Placement of sighters 5

Line clearing 5
Strainer assemblies 5
- Materials 5
- Type of assembly 5
- Post depth 6
- Strut length 6
- Concrete versus rammed dirt 6
- Where to tie the in-line wires 6
- Strut alignment 6
- A prefabricated steel end assembly 7
- Strainer assemblies at fenceline corners 8
- The continuous strainer-to-strainer method 9

The wire 9
- Trailed barbed wire jenny 10
- Tying off in-line wire to a strainer assembly 11
- Wire strainer tension meters 11
- Tension loss in high tensile barbed wire fencing 11

Tie wire 11
Line posts 11
- Tying in-line wire to a steel picket 12
- Positioning of line posts 12

Fence droppers 12
Preventative maintenance 12
Appendix A: Typical wire spacings for cattle control 13
Appendix B: Freight weights 14
Appendix C: Construction hints 14
Appendix D: Further reading 14

Introduction

The sub-division of pastoral leases with fences promotes better control of the grazing animal, reduces mustering costs, and simplifies the imposition of management strategies designed to lift the productivity of pastures and stock.

However, fencing represents a considerable capital investment and a commitment to fence maintenance.

The adoption of good construction techniques gives the best result for the dollar spent and reduces maintenance requirements in following years.

This Bulletin highlights some of the more important construction aspects for barbed wire fences.

Fenceline pegging

Topographical maps, air photos and your own knowledge of the area can be used to determine the alignment of a new fence. Important considerations include:

- the purpose of the fence;
- likely physical obstructions, for example, rock outcrops and creek crossings;
- any deviation from the shortest distance, as this increases costs;
- the number of corners in the fence - the more corners there are the higher are initial construction and future maintenance costs;
- the quantity of timber likely to be encountered during line clearing. Slight changes in alignment may marginally increase fencing costs but significantly reduce clearing costs.

Having decided on the alignment for the fence check and peg the line to make sure there are no unforeseen obstacles to establishing the fence on the theoretical alignment. For example, sheet limestone at shallow depth which could not be detected on the map or air photo.

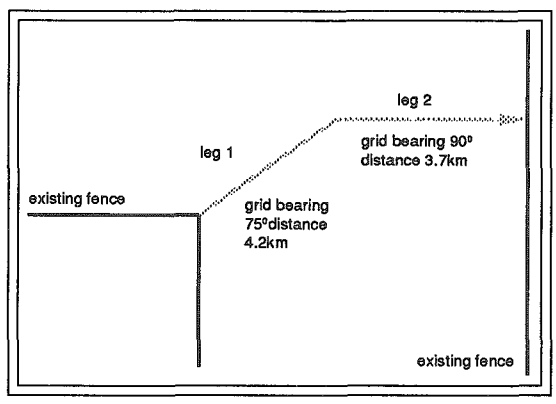


Figure 1. Measuring grid bearings.

Checking the line

- Measure the grid bearings and the length of each leg from a topographical map (Figure 1).
- Calculate the magnetic bearing from the grid bearing. This must be done so that the bearing on the compass corresponds with the bearing on the map. The variation between grid and magnetic bearing is the result of magnetic north not being at the North Pole and because of errors introduced when the maps are drawn.

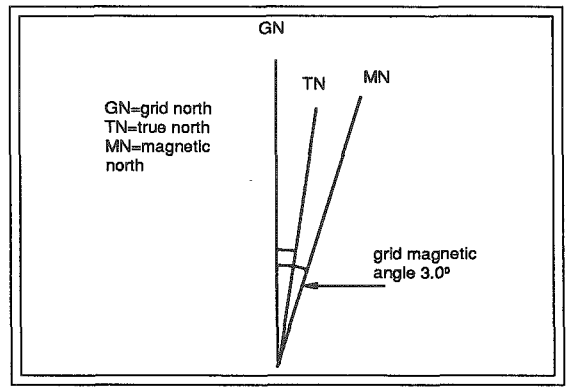


Figure 2. Diagram of magnetic variation printed on a map.

In the bottom left hand corner of every topographical map (1:100,000) is a diagram which indicates the magnetic variation for that map sheet (Figure 2).

The grid-magnetic angle will be given, together with any correction due to the movement of magnetic north over time. Operate to the nearest 0.5 degree because that is usually the limit of accuracy of most hand-held compasses. Below the map diagram will be the following statement.

"To convert a magnetic bearing to a grid bearing add grid-magnetic angle."

Conversely, to convert a grid bearing to a magnetic bearing SUBTRACT grid-magnetic angle.

For the example given in Figure 1, leg 1 is 4.2 km at a magnetic bearing of 72° and leg 2 is 3.7 km at a magnetic bearing of 87°.

- Both the legs of the proposed fence can then be traversed in a vehicle using the compass for direction and the odometer for measuring the distance. Do not use the compass in, or close to, the vehicle as its accuracy may be impaired. The junction between leg 1 and 2 should be marked (with flagging tape if available) for future reference.

Make sure the compass bearing is taken carefully. An error of 1° over 1 km results in a 16 m lateral error.

Placement of sighters

After making the required calculations and physically checking the desired alignment, you can then start setting out sighters.

- Drive a picket to about 20 cm depth at the start point (all 'sighters' should only be driven to this depth so that they may be removed or their position changed as required). Tie flagging tape onto the picket to make it easier to see.
- Sight forward from the start point and move down the proposed alignment 200 m (check the distance from the start point using the vehicle odometer). Tap in a second picket.
- Back sight from a point 20 m past the second picket back to the start picket.

The backsight angle is 180 degrees greater or less than the forward sight.

For example:

forward sight		back sight
124 °(+180 °)	=	304 °
321° (-180 °)	=	141 °

Any barrier to sighting, such as a bush, must be removed from the line.

- Move down the proposed fenceline in 200 m intervals, back sighting; using the 'sighter' pickets already driven.
- Check the vehicle odometer to determine when the end of leg one has been reached. Continue down leg two as per leg one.

Make sure the 'sighter' pickets are not disturbed during line clearing operations.

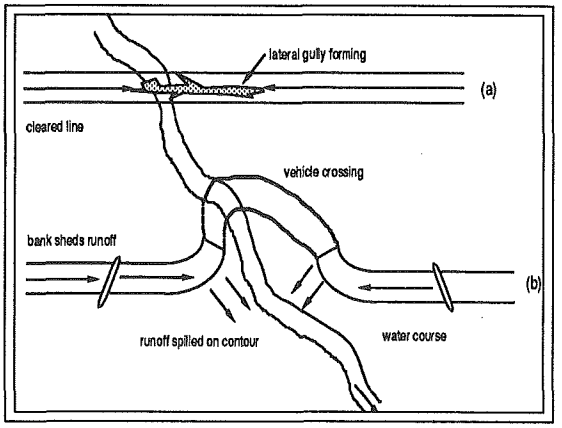


Figure 3. A practical method of line clearing through a water course (a) incorrect, (b) correct.

Line clearing

The purpose of line clearing before fence construction is to:

- create enough room either side of the proposed fence for ease of construction;
- create adequate access for future maintenance;
- make the new fence more visible to stock;
- reduce the risk of fire damage in subsequent years.

Line clearing should remove vegetation which would hinder construction but should *move as little soil as possible.*

The movement of soil promotes erosion by:

- the interception of overland flow by the excavation created;
- concentration of overland flow by the resulting windrow created by excavation.

Line clearing should not take place through water courses as this often leads to lateral gullies working back up the fence line on either side of the water course.

A more satisfactory method is shown in Figure 3.

It is inconvenient to have to cut the in-line wire, move the vehicle to the other side of the creek, and pull out and rejoin the wire. However, it is not as inconvenient as having to pull the fence out of the bottom of a gully within five years.

A fenceline that is badly eroded becomes less effective as a barrier to stock (because the distance between the ground and bottom wire may become too great) and is far more difficult to maintain.

Strainer assemblies

The following points are important when constructing strainer assemblies.

Materials

Experience in the Kimberley indicates that steel is the only material worth using (except in some saline conditions). It simplifies construction to the correct geometry and it has strength and durability.

Type of assembly

Box assemblies are 25 per cent stronger than diagonal stay assemblies of similar proportion (Figure 4).

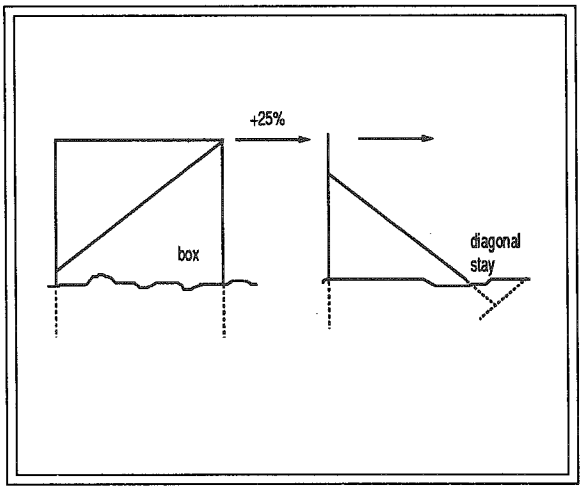


Figure 4. Box assemblies are stronger than diagonal stay assemblies of similar proportions.

Concrete versus rammed dirt

It is impossible to ram dry dirt back around an upright post and achieve a satisfactory result. Concreting the uprights into a jagged, slightly bell shaped, hole gives a better result.

Where to use them

Strainer assemblies need only be used at the beginning and end of a length of fence and also where it changes direction.

Strut alignment

It is important to locate strainer assemblies correctly so that they have the best chance of doing the job for which they were designed. An end assembly which is not in alignment with the fence will have reduced effectiveness. The forces exerted on it will reduce the support normally afforded by the forward upright (Figure 6).

Post depth

The ability of a post to withstand lateral movement is directly proportional to the square of the depth that is in the ground. For example, a post 94 cm in the ground can withstand a lateral load 1.5 times greater than a post 76 cm in the ground.

Where to tie the in-line wires

In-line wires should not be attached to the post closest to the fence. The wire should always be attached to the upright furthest from the fence (Figure 5).

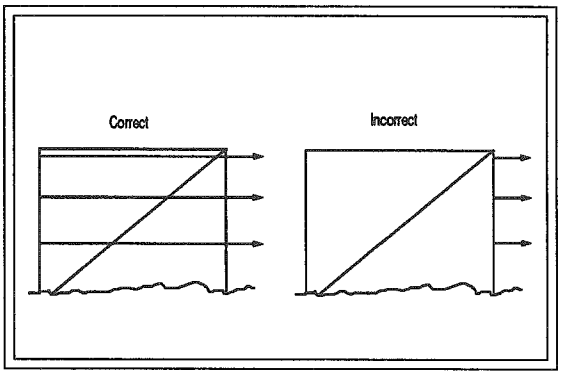


Figure 5. In-line wires should always be attached to the upright furthest from the fence.

Table 1. The load the assembly will carry

	Single span 2.4 m	Single span 3.3 m
Total load carried	18 kN (1840 kg)	29 kN (2960 kg)
Horizontal movement at 13 kN	100 mm	40 mm
Vertical movement at 13 kN	50 mm	15 mm

Strut length

The horizontal strut should not be less than 3 m long. The shorter the strut the greater the 'jacking effect' on the assembly.

The longer the horizontal strut the more load the assembly will carry, as shown in Table 1.

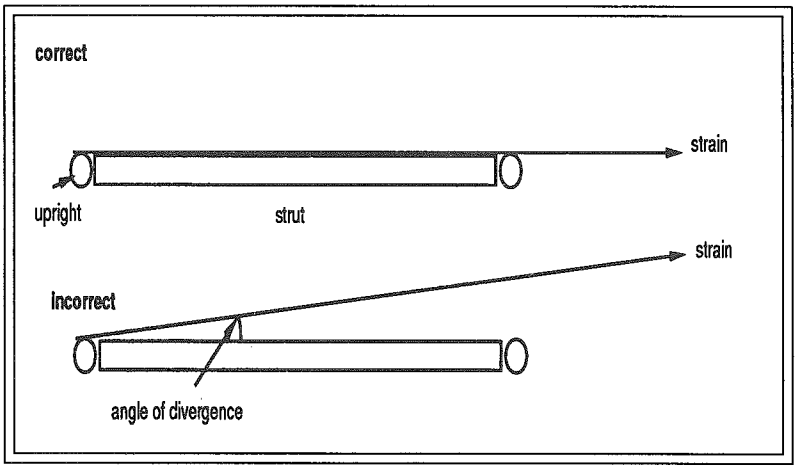


Figure 6. An end assembly not aligned with the fence is less effective than one that is aligned.

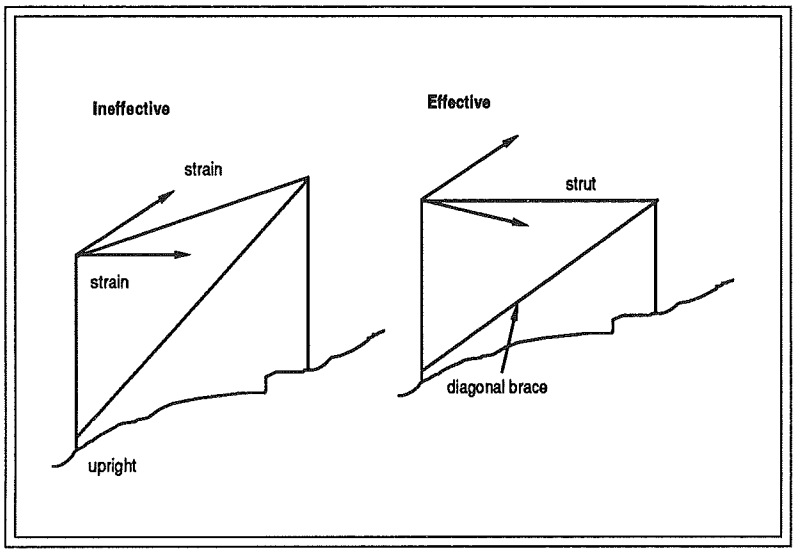


Figure 7. The strut should always be at right angles to the uprights.

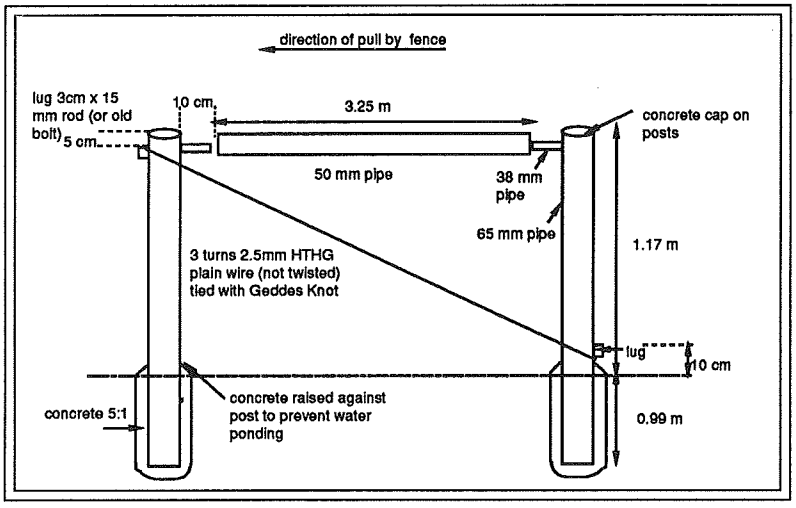


Figure 8. 'Exploded' diagram of strainer assembly (not to scale).

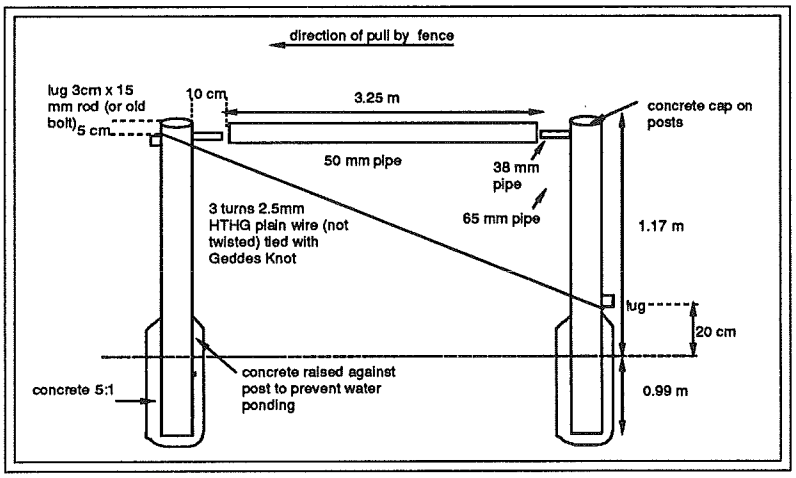


Figure 9. 'Exploded' diagram of strainer assembly for saline conditions (not to scale).

The greater the angle of divergence between the strut and the in-line wire, the less effective the strainer assembly becomes.

The strut should always be at a right angle to the uprights. Where a fence line skirts a hill, and an assembly is used to bisect a corner angle it may be necessary to have uprights of differing length to maintain the correct relationship between upright and strut (Figure 7).

A prefabricated steel end assembly

A number of fence failures (particularly suspension fences) are caused by poor design and construction of the end assembly. As most fences are constructed solely with steel components, it is sensible to also construct the end assembly of the same material so as to give all components a similar lifespan. Steel also has the advantage of being insect and fire proof.

With a prefabricated design all cutting and welding can be completed in the workshop, reducing the amount of gear to be transported to the fenceline.

Figures 8 and 9 illustrate the components and design of the assembly.

A 6.5 m length of 65 mm black pipe will provide three uprights the length of those shown in Figure 8. In most soils this length will be enough. Problem soils may need a greater length of upright below ground level. Struts need to be at least 3 m long to provide strainer stability; halving a 6.5 m length of 50 mm black pipe provides two struts as illustrated.

Railway iron or bore casing may be substituted for the black pipe in the construction of uprights.

Sequence of construction:

- In the workshop, measure, cut and weld steel as per diagram

- Locate position for uprights and dig holes to required depth.
- Concrete in uprights ensuring that the uprights are truly vertical and the strut horizontal (use a spirit level). Ensure that the uprights are in alignment with the fence.
- Leave concrete seven days to cure.
- Position diagonal stay using 2.8 mm or 2.5 mm Tyeasy HTHG* plain wire. Three wraps will suffice. Strain up as tight as possible (making sure wire is not crossed up around the lugs) and tie off using a Geddes knot (Figure 10).
- Spray knot and lug area with cold galvanizing aerosol.

The cost of the strainer assembly is a fraction of the total cost for a number of kilometres of fence.

Strainer assemblies at fenceline corners

Where a fenceline changes direction it is common to install a double box strainer assembly. Problems arise with this type of structure because there is an increased load acting on the upright at the apex of the corner, and at the same time the effective strut length is reduced. Figure 11a illustrates this point.

The effective strut length is very important and becomes critical when the strut is less than 2.7 m long.

To overcome this problem construct a normal box assembly which bisects the corner (Figure 11b). Where the angle is 90 degrees the loading on the strainer is 40 per cent higher than an equivalent end assembly on the same fence. The smaller the angle the greater the load on the strainer assembly. With corners of less than 90 degrees it may be necessary to modify the bisecting box assembly by increasing post depth.

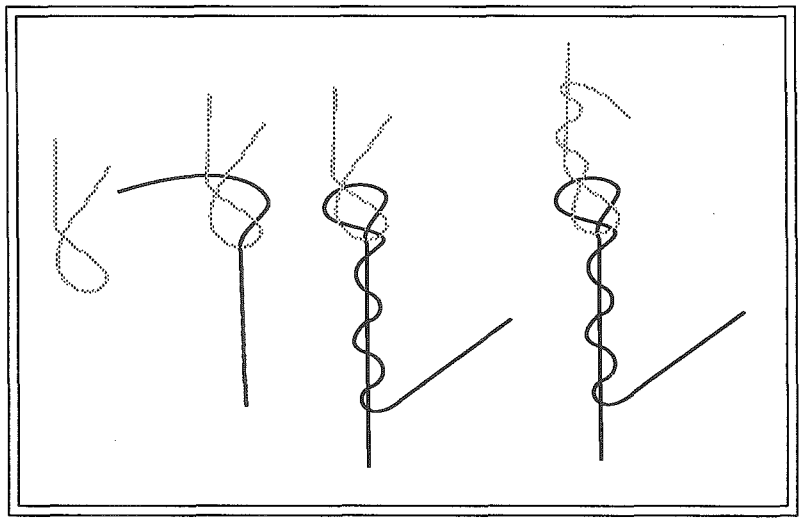


Figure 10. Tying a Geddes knot.

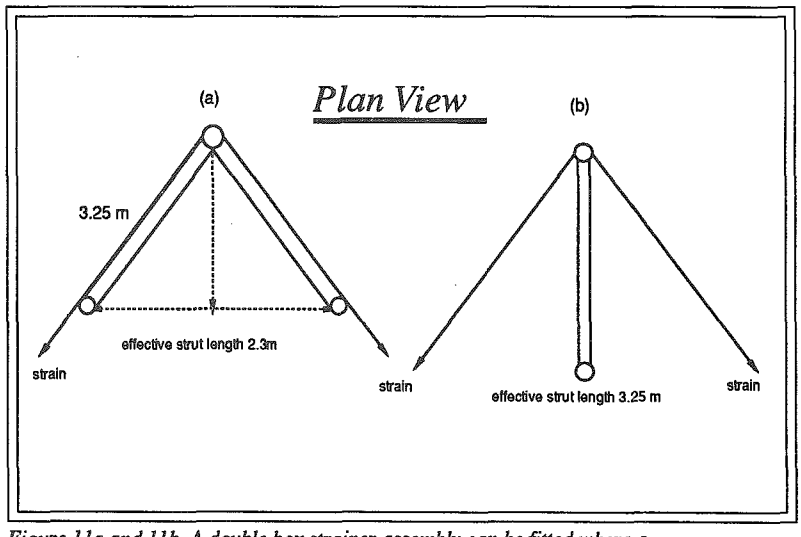


Figure 11a and 11b. A double box strainer assembly can be fitted where a fenceline changes direction, but this increases the load acting on the upright at the apex of the corner.

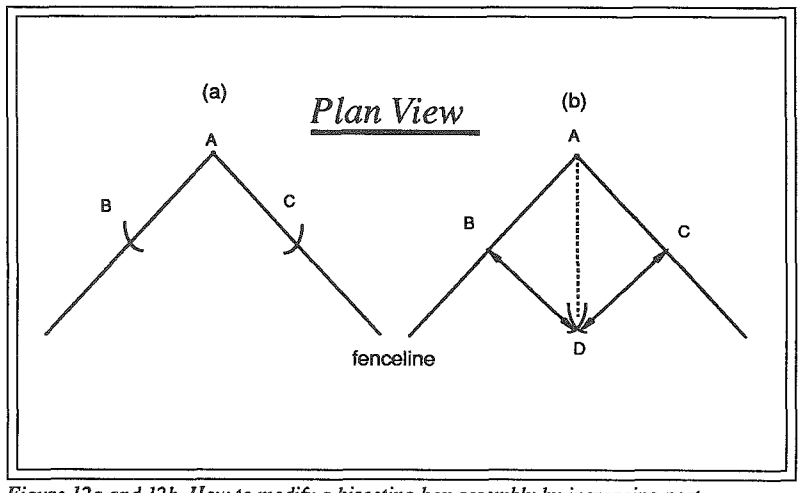


Figure 12a and 12b. How to modify a bisecting box assembly by increasing post depth.

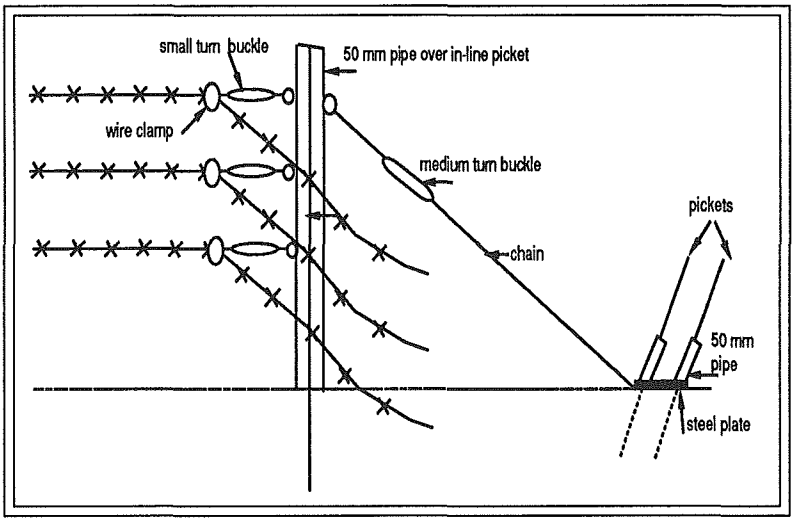


Figure 13. Design of temporary strainer to save time and materials.

- Use a tape measure, string, or a length of fencing wire to scribe arcs on the fencelines (at B and C) equidistant from the apex A of the corner (Figure 12a).
- Then scribe arcs BD and CD so that the arcs cross each other at D. The line AD then bisects the angle BAC (Figure 12b).
- The bisecting box assembly may then be installed with one post at A and the other on the line AD.

The bisecting box assembly produces a more effective structure and also needs less materials for construction than a double box assembly.

Temporary in-line fence strainer posts

When constructing barbed wire fences, it has been standard practice to use an in-line strainer (usually single timber or steel posts) at the end of each coil of wire. Once the fence is completed the loads on either side of that in-line strainer cancel each other. Thus in the completed fence, the strainer behaves as a steel picket. Its ability to hold the fence, should a main strainer fail, is limited to a short length of fence on either side of it.

The use of temporary strainers saves time and materials. A temporary strainer design is illustrated in Figure 13.

Method of operation:

- Step 1. Tie three wires to the end assembly and run out the first three coils.
- Step 2. Join the second three coils (at 500 m) and run out to 1 km (end of second coils).
- Step 3. Pull up slack with vehicle.
- Step 4. Install a temporary strainer at the end of second coils (1 km) and place barbed wire into wire clamps.
- Step 5. Return to joins between coils (at 500 m mark) and strain to the desired tension (pulling up 500 m in each direction).
- Step 6. Return to 1 km point (second operator remains to tie barbed wire to pickets and fix droppers if needed).
- Run out another six coils to 2 km and repeat steps 3 to 6 only, this time finishing up at the 2 km point.
- Loads on the first temporary strainer (at 1 km) should be close to equal and the wire removed from the clamps (using the turn buckles if needed).
- First temporary strainer is then removed to the 3 km point, and so on.

The continuous strainer-to-strainer method

Simply run out the in-line wire from strainer to strainer, pulling up the slack at each join in the process. At the far strainer pull the fence up to the required tension. Then go back to each join and the first strainer, pulling up again to required tension. Surveyors tape tied at the joins ensures easy relocation.

Once all the wire has been pulled up to the required tension, it can be tied onto the posts and the droppers fixed to the wire.

The wire

There are two types of barbed wire available: Iowa pattern and High Tensile.

Iowa barbed wire is made from 2.5 mm diameter soft wire in a continuous twist pattern with barb spacings at 100 mm intervals. It is available with either standard or heavy galvanized coating.

High tensile barbed wire is available in two sizes, 1.57 mm diameter and 1.8 mm diameter. The 1.57 mm high tensile wire has

Table 2. Barb wire characteristics

Wire	Length per reel (m)	Approx weight per reel (kg)	Recommended tension
2.5 mm Iowa	400	45	1.3 kN (136 kg)
1.57 mm HT	500	24	1.3 kN (136 kg)
1.8 mm HT	500	28	1.3 kN (136 kg)

a similar strength to Iowa. The 1.8 mm high tensile is stronger than Iowa.

High tensile barbed wire is produced in a reverse twist pattern and has barbs at 90 mm intervals (Table 2).

The 1.57 mm high tensile wire is unsatisfactory where there is a high fire risk. The 1.8 mm HT wire is better and Iowa is best in these situations.

Barbed wire may be run out from a home-made vertical spinner, a trailed horizontal jenny, or by walking along the fenceline with a bar passed through the centre hole in the reel.

Trailed barbed wire jenny

Figure 14 shows a trailed barbed wire jenny which has some advantages over the more common vertical spindle jennies. These are:

- less snagging
- no overrun
- safer, because the wire is always in contact with the ground
- the wire does not slip off the roll onto a spindle and jam
- liveweight and easily transported
- simple low cost construction using off-cuts and 'scrap'.

However, this type of jenny does not operate well when rolls of unequal diameter are used. The last 5 m of wire on the rolls must be discarded because of damaged galvanizing.

To load the jenny, remove the timber reels from the rolls of barbed wire and place the jenny barrels into the rolls so that they unroll in a clockwise direction (drawing view). The barrels are then 'locked' into place using the barrel bar which in turn is secured by a retaining pin.

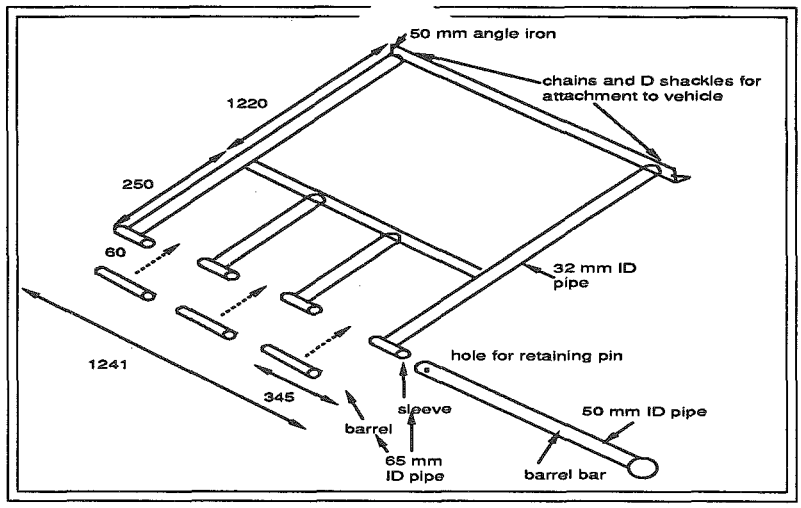


Figure 14. A trailed barbed wire jenny.

Tying off in-line wire to a strainer assembly

Method

- Tie the wire strainer chain to strainer assembly upright by running the free end around the upright and back through the jaws (Figure 15).
- Attach wire strainer jaw to in-line wire and wire strainer claws to chain.
- Tension in-line wire to required tension, and tie off to upright.
- Ease tension off and remove wire strainers.
- Strain other in-line wires in a similar manner.

Note. Strain wires in the following order: top, middle, bottom.

The in-line wire nearest the line posts goes to the top of the fence.

High tensile wire may be tied off directly to the steel strainer upright which means:

- No soft wire components in the high tensile in-line wire.
- Many fewer knots (and they are always a weak point in any fence).
- A saving of time during construction.
- Fewer fence components.

Wire strainer tension meters

To achieve optimum performance from fence wire (especially high tensile wire), all in-line wires need to be pulled up to the same working load. If this is done, all in-line wires work together (aided by dropper load transference) to stop the impact of a beast. Unequal tensioning may lead to one wire taking a disproportionate amount of the load and breaking.

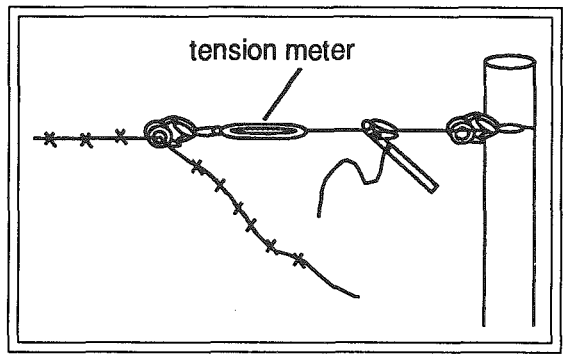


Figure 15. Tying off in-line wire to a strainer assembly.

The tension meter is attached to the wire strainers as per diagram. This allows constant checking of the metered load during tensioning.

Tension loss in high tensile barbed wire fencing

Tension loss is almost always caused by the shortening of the distance over which the in-line wire has been tensioned. This is brought about in the following way:

- By the inward movement of the strainer assemblies at each end of the fence.

Setting the uprights deep (at least 1 m) into the ground and the adoption of a long horizontal strut (at least 3 m long) will reduce this inward movement.

Steel assemblies are not subject to shrinkage and distortion, unlike those constructed of timber.

- By the movement on in-line posts to accommodate the forces that wire tension puts upon them.

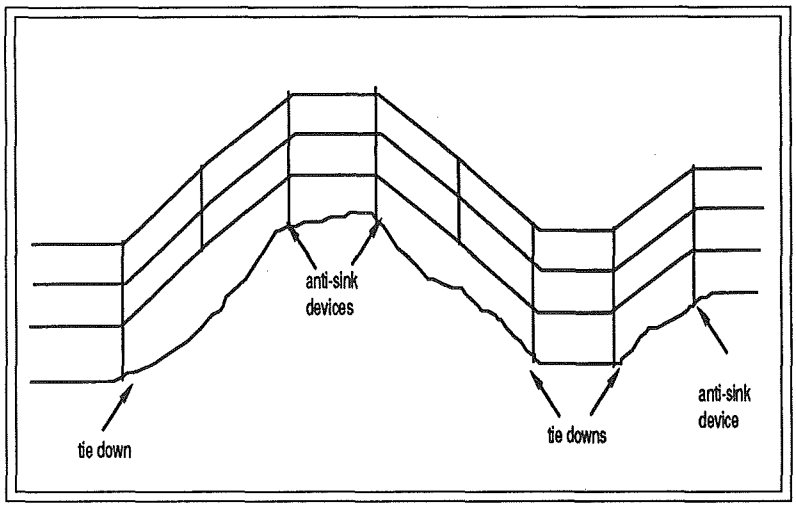


Figure 16. Anti -sink or anti -lift devices should be attached to fences to minimize tension losses.

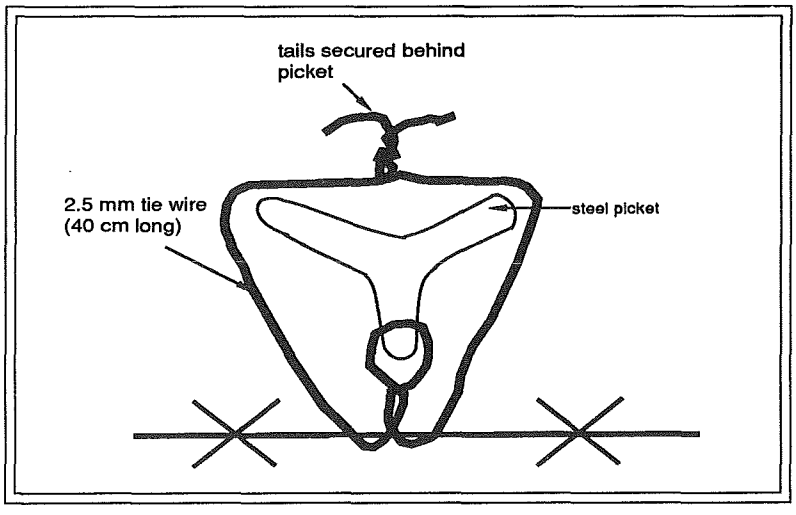


Figure 17. Tying wire to a steel post.

Those posts subject to vertical forces should have anti lift or anti sink devices attached to them respectively (Figure 16).

The straighter the fence line between strainers and the fewer the number of in-line posts, the lower the risk of tension loss.

Long strains result in lower tension losses.

Hot fires may affect the elasticity characteristics of the wire and even cause breakage. Fence lines needs protection from fire to maintain peak performance from high tensile fence wire.

Tie wire

Soft wire, 2.5 mm diameter, is adequate for most tying. Wire of smaller diameter is not strong enough for general application.

Forty centimetres of tie wire is enough to attach the in-line wire to a steel picket.

Line posts

The functions of line posts are to:

- support and space the in-line wire component.
- give the fence resistance to overturning.

The two materials commonly used for line posts are steel and termite resistant timber (used mainly in saline situations).

Tying in-line wire to a steel picket

In-line wire is held off steel posts by the use of tie wire, to prevent corrosion. Corrosion is caused where electrolysis takes place between the steel of the post and the in-line wire.

Corrosion occurs in two phases. The galvanizing is lost from the wire, and the steel in the wire rusts. These processes are continuous, gradually reducing the strength of the wire until it breaks.

Wire is tied to a steel post as shown in Figure 17. With this arrangement it is the tie itself which is subject to corrosion and not the in-line wire.

Positioning of line posts

Line posts should be located where they will be most effective. This sometimes offends the eye, however the aim is to create an effective stock barrier, not a work of art.

Fence droppers

The role of fence droppers is to:

- maintain vertical wire spacings.
- transfer impact loads to all in-line wires.
- increase fence visibility.
- enhance fence flexibility.

Droppers should never touch the ground as this acts against the design principles in high tensile fencing.

Where a number of droppers are used per panel, they should be fixed on alternate sides of the in-line wire. This gives the fence 'balance', important where wide post spacings are used. The correct way to attach the droppers to the fence is shown in Figure 18.

Dropper length should closely match the vertical distance from the top to the bottom in-line wire. Any additional length adds weight to the fence, causes greater sag and increases the cost.

Rigid droppers are superior to wire types in transferring impact loads.

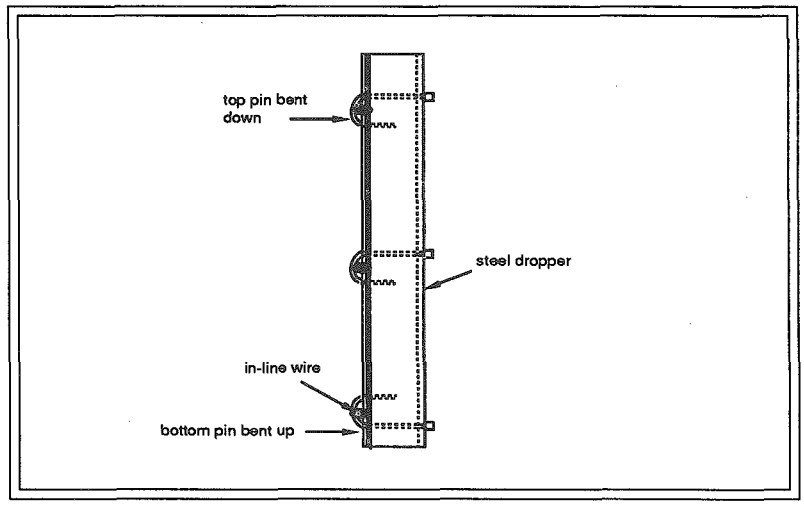


Figure 18. Pinning in-line wire to a rigid steel dropper.

There is no hard and fast rule as to the best spacing of droppers. Each length of fence will have to be assessed on its own merit. Considerations will include:

- topography,
- animal pressure,
- wire tension.

Preventative maintenance

Preventative maintenance consists of attention to:

Initial construction

A fence should be aligned to minimize the number of potential trouble spots such as creeks.

High quality fence components should suit the environment, for example, don't use steel pickets in highly saline conditions.

A high standard of construction will reduce maintenance requirements.

Protection from fire

Firebreaks will protect the fence from fire and allow woody weeds to be controlled within and near the fenceline. Hot fires radically alter the characteristics of fence wire. In severe cases, the wire may fail totally.

Fence access

Access to fence line must be maintained to allow for wire maintenance operations.

Visibility to grazing animals

The fence must be visible to domestic stock and feral animals. This will result in fewer animal impacts on the fence and consequently lower maintenance requirements.

Appendix A

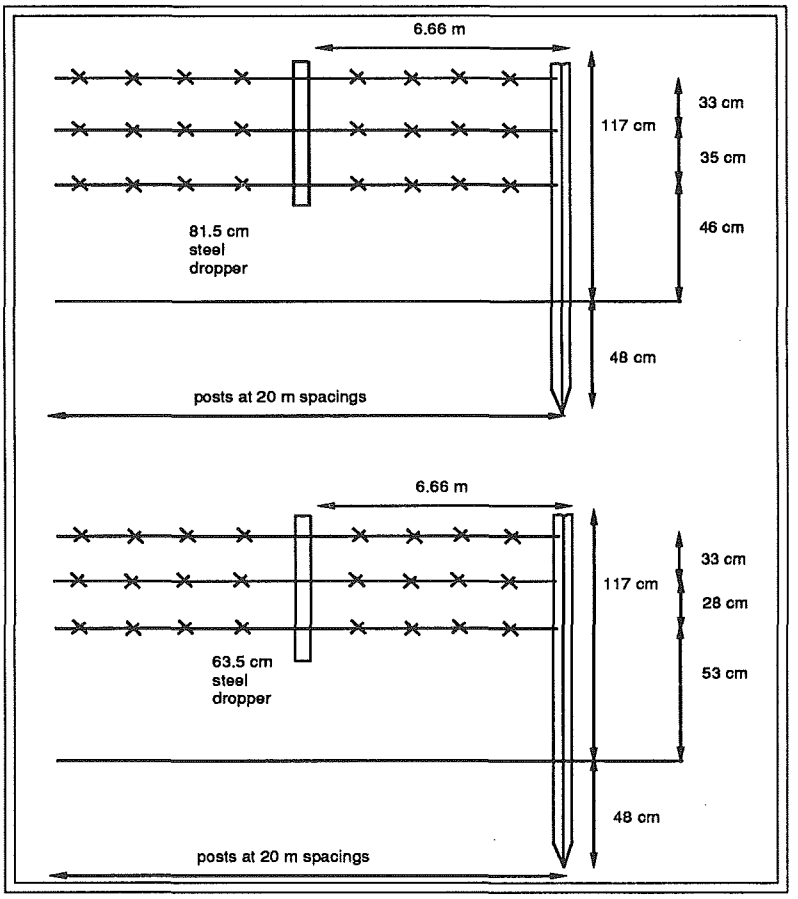


Figure 19a. Typical wire spacings - 3 barb station sub division (high tensile) - for cattle control.

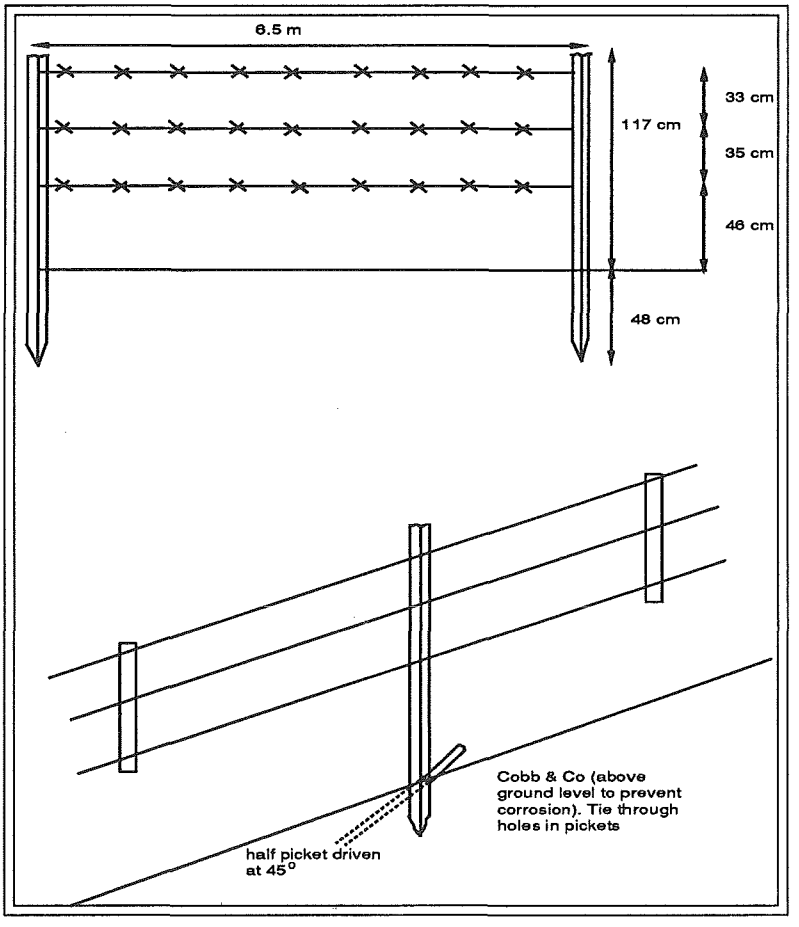


Figure 19b. Kimberley cattle fence (Iowa Pattern barb wire).

Appendix B

Freight weights of commonly used barbed wire fencing materials

Appendix B. Freight weights of commonly used fencing materials

Item	Unit	Nominal weight (kg)
2.5 mm Iowa pattern barbed wire (standard galv.)	Roll	45
2.5 mm Iowa pattern barbed wire (heavy galv.)	Roll	46
1.57 mm HTHG barbed wire	Roll	24
1.80 mm HTGH barbed wire	Roll	28
2.50 mm standard galv. tie wire	Roll	58
165 cm steel pickets	Bundle (10)	34
63.5 cm steel fence droppers	Bundle (50)	13
81.5 cm steel fence droppers	Bundle (50)	17

Appendix C

Construction hints

- Place sighter pegs as far apart as visibility allows (about 200 m).
- When sighting in-line posts - SIGHT FORWARD - never look back.
- Use leather gloves during construction - higher work rates will be achieved.
- The double-loop knot is an effective and convenient method of joining in-line wire.
- Pick up the off-cuts and dispose of correctly, otherwise stock and vehicles may be damaged.
- Use top quality chain, shackles and swivels on wire strainer to prevent accidents.

Appendix D

Further reading

Boorman, A.J. (1979) Cattle fencing, Queensland Agricultural Journal, 105 (6):52.

Waratah Fencing Manual, From Australian Wire Industries Pty Ltd, 76 Leath Road, Naval Base, WA, 6165.

678/10/90/2M